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AMOUNTS OF DUNG BURIED AND SOIL EXCAVATED BY CERTAIN COPRINI (SCARABAEIDAE) (1)

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The agencies of nature involved in affecting soil manipulation, interchange and fertilization are varied and numerous. The opening and agitation of the soil and the incorporation of organic matter by insects and other animals undoubtedly have resulted in a beneficial effect upon the earth's crust. The part which insects have had in these operations has not been investigated in sufficient detail.

It was the object of these investigations to review the literature on insects as soil builders and to obtain and present data in regard to the habits of dung beetles. These data are concerned with the amounts and kinds of organic materials deposited in the earth, amounts of soil excavated, and some burrowing habits of a few dung beetles of the tribe Coprini.

LITERATURE REVIEW

A review of the literature reveals chiefly the following points: (1) a dearth of definite quantitative work on the incorporation of organic materials into the soil by insects, (2) a difference of opinion regarding the value of insects as soil builders, (3) a few investigations on

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the insect population of the soil, and (4) a number of observations on ants as geologic agents.

Morris (1920, 1922, 1927) determined the insect population of the soil in various environments in England and found that the number of underground inhabitants to the acre reached the millions. McAtee (1907) and Felt (1928) have also made estimates on the insect population of the soil.

McColloch and Hayes (1922) point out a reciprocal relationship existing between soil and insects. McColloch (1926) shows some ways in which insects cause a deleterious effect upon the soil. Morris (1922), after a chemical analysis to show the nitrogen content of the various groups of soil invertebrates, concludes that although the bodies of invertebrate fauna contain an appreciable amount of nitrogen, there scarcely can be any loss or gain due to them. Cameron (1925) states that it is unlikely that soil insects contribute to fertility, although their habit of burrowing may aid in soil aeration. Lutz (1931) states that insects are more effective than earthworms as soil builders. He attributes this to the greater distribution and numbers of insects, and to the fact that insects carry materials rich in nitrogenous plant food beneath the surface of the soil.

Branner (1900) states that in tropical regions ants and termites are vastly more important as geologic agents than earthworms of temperate regions. Shaler (1891) calculates that ants in certain fields in Massachusetts transfer annually sufficient material from the subsoil to cover the surface to a depth of one-half centimeter. McCook (1877) states that in the mountains of Pennsylvania ants build large mounds commonly measuring 10 to 12 feet in circumference and two and one-half to three feet in height.

METHODS

These investigations were conducted at Manhattan, Kansas, beginning in the fall of 1929 and continuing through 1930. This work consisted of field and insectary studies to determine the burrowing habits of dung

beetles. Semi-weekly trips were made to pastures and fields for observation and excavation of these underground insects. An attempt was also made to determine the dung beetle population on seven one-tenth acre areas. The types of pastures investigated were highland, lowland and sandy areas which supported various kinds of vegetation including: native prairie, blue, Sudan, brome and orchard grasses and sweet clover.

When a burrow was found, which was indicated by a mound of soil, its diameter, length, depth and character of passage-way were recorded. The soil, manure and insect responsible for the burrow were collected. Six weeks were allowed for air-drying the soil and manure before weighing. Difficulties were often encountered in excavation of burrows because of the winding and twisting path of the tunnels.

Soil under old cattle droppings was examined for dung beetle larvae which were located in small balls of manure. These insects were reared at the field insectary.

PRESENTATION AND DISCUSSION OF DATA

Besides various ecological notes, numerical data were obtained on 70 burrows belonging to species of the tribe Coprini. The numbers of burrows of each species are as follows: **Pinotus carolinus** (L) 24, **Copris tullius** Oliv. 25, and **Phanaeus** spp. 21.

It is believed that some of the dung beetles are probably native of Kansas, although no evidence was found in the literature to confirm this supposition. That dung beetles were present at an early date is shown by Thomas Say's report (1823) describing coleopterous insects collected in an expedition to the Rocky Mountains in which are mentioned many species of dung beetles. LeConte (1859) published a list of Kansas Coleoptera which included **Phanaeus carnifex** L. and **Onthophagus hecate** Panz.

The beetles encountered in this study belong to the tribe Coprini, representing four genera and including six species, namely: **Pinotus carolinus** (L), **Copris tullius** Oliv., **Phanaeus carnifex** L., **Phanaeus difformis** Lec., **Onthophagus pennsylvanicus** Har., and **Onthophagus hecate** Panz. These beetles were found in every environment where cattle grazed, including native prairie, blue,

Sudan, brome and orchard grass and sweet clover pastures. In pastures where both cattle and horses grazed the horse droppings were rarely utilized.

May and the first part of June comprised the months of greatest burrowing activity. During the middle of the summer there occurred a decrease in the amount of burrowing, while after the rains in August increased activity was observed. The period of depression in burrowing may have been due to the extremely hot and dry weather prevailing at that time. Nearly every day temperatures of 100 degrees F. were recorded, and much of the time 105 degrees to 110 degrees F. were registered.

Pinotus carolinus (L.)

The burrows of **Pinotus carolinus** (L.) were easily distinguished from those of other dung beetles by the larger mounds of excavated soil, large particles of soil and greater diameter of tunnel. They were usually located within a few inches of fresh cattle droppings. When two or three mounds encircled a dropping, practically the entire amount of dung was utilized. The soil, which is pushed out of the tunnels, often clings together forming cylinders one-half to two inches in length. The main characteristic of these burrows was a branch leading away from the main tunnel at five to 25 centimeters below the surface of the ground. (Plate I, Figs. 1 and 2.) The branch, usually shorter than the main tunnel, contained stored dung. Often a small amount of dung was found in the termination of the main passage-way.

The first burrowing of **P. carolinus** in the spring of 1930 was observed on May 3. Fresh burrows could be located any time during the spring, summer and fall. The last extensive burrowing took place on October 5. A single fresh mound was observed on October 17, and another on October 25.

Table I shows the data obtained on each individual burrow. An examination of the table shows that the lengths of the main tunnels did not vary a great deal except in one case where the length was 162 centimeters. The diameters of the burrows were uniform as would be expected. The depths were also similar except for a few extremes. Considerable variation is evident in the weights of soil and manure.

TABLE I

Data on 21 Spring, Summer, and Early Fall Burrows of **Pinotus carolinus.**

Dimensions of burrows in cm.				Weight of soil in grams	Cubic contents of burrows in cc.	Weight of manure in grams	Number of beetles in burrow
Length of main tunnel	Length of branch	Diameter	Depth				
30	6	2.6	18	96.4	191.1	16.1	1
45	ruined	2.2	17	109.4	171.0	ruined	1
15	5	2.5	11	ruined	98.0	6.2	1
25	7	3.0	15	120.1	226.1	17.3	1
45	23	3.2	17	302.1	546.8	51.6	2
26	20	2.7	10	182.0	262.9	37.1	2
29	4	3.0	14	182.9	233.2	11.1	1
33	10	3.0	16	186.2	303.9	26.9	1
57	ruined	2.5	12	191.5	279.3	28.8	1
30	4	2.6	10	ruined	180.5	ruined	2
00	38	2.7	27	70.8	560.2	62.2	2
40	12	2.6	22	123.5	276.0	64.3	1
50	40	2.7	32	385.3	514.3	130.5	2
21	38	2.7	22	229.2	337.3	110.8	1
11	31	2.8	10	ruined	258.5	63.5	1
47	ruined	2.8	21	309.3	289.3	14.0	2
162	26	2.7	55	815.9	1074.7	66.2	2
	Not recorded			1220.9*		ruined	1
35	33	2.6	36	184.9	350.3	19.5	1
32	11	2.7	23	171.2	245.8	21.5	1
85	49	3.2	21	ruined	1077.6	119.4	2
Av. 43.9	21	2.74	20.4	287.1	373.8	48.5	

*Not included in calculating average.

The amount of dung stored by these beetles varied from 6.2 to 130.5 grams, while the average was 48.5 grams. These weights are rather low, but it must be remembered that dry manure is comparatively light; a few grams represent a volume greater than would naturally be expected. Since dung beetles and their larvae are known to feed on dung, the question arose as to whether or not all the manure in the burrows was consumed. By excavating some burrows in December which had been marked previously, it was found that not all of the dung had been consumed. As a matter of fact, a considerable amount remained, all in a state of decay. This was true with all the dung beetles studied. The portion of manure which was eaten by the beetles would not necessarily be lost as far as a fertilizer is concerned, because beetle feces would no doubt contain materials which are beneficial to soil. Beetle feces were found in abundance in the burrows. Juritz (1920) found caterpil-

lar dropping to compare favorably with other manures in beneficial soil elements.

The amount of soil brought to the surface by **P. carolinus** was enormous in comparison with that of other dung beetles studied. The amount varied from 70.8 to 1220.9 grams, with an average of 287.1 grams.

On September 17, two one-tenth acre plots were measured off in different parts of a pasture and a count taken of fresh mounds of **P. carolinus.** There were 15 mounds on one plot and 25 on the other. This distribution would make an average of 200 burrows to the acre. Observations in the spring indicated that the population was as great as this in some areas and less in others. Two hundred burrows on an acre would indicate the burial of approximately 21 pounds of air-dried dung and the excavation of 126 pounds of soil. This is not a large amount, but when it is taken into consideration that dung burial takes place continuously during spring, summer and early fall, and that the process is probably repeated yearly, it appears that a considerable amount of manure would be deposited in the soil. Since there are many species engaged in these same operations, it is believed that dung beetles may be recognized as an important factor in soil fertilization and soil interchange.

TABLE II

Showing Data on 23 Spring, Summer, and Early Fall Burrows of **Copris tullius** Oliv.

Dimensions of burrows in cm.				Weight	Weight of	Number of
Length	Diameter	Depth	Manure cavity approximately	of soil in grams	manure in grams	beetles in burrow
8	1.0	5.5	2.0x3.0	5.8	1.3	1
6	1.2	5.5	1.8x3.5	No Col.	1.4	1
6	1.2	5.0	1.4x2.5	No Col.	0.9	1
7	1.2	5.0	2.0x2.8	No Col.	1.9	1
4	0.9	2.0	1.5x1.5	No Col.	1.6	1
11	1.0	9.0	2.0x2.0	No Col.	0.7	1
12	1.1	10.0	1.8x2.0	No Col.	1.1	1
16	1.3	15.0	3.5x3.5	73.6	5.1	2
14	1.2	12.0	3.0x3.5	51.5	10.8	2
16	1.2	13.0	3.0x5.0	65.3	16.4	1
12	1.2	10.0	4.0x5.0	62.6	18.1	2
18	1.1	10.0	Not recorded	No Col.	No Col.	1
10	1.0	8.0	4.0x5.0	No Col.	10.8	2
17	1.0	10.0	4.0x5.5	No Col.	12.7	1
18	1.1	9.0	3.0x5.0	No Col.	9.5	2

(Table II Continued on Page 115)

(Table II Continued from page 114)

16	1.2	10.0	2.0x2.2	12.9	5.6	1
15	1.1	8.0	Not recorded	No Col.	8.2	1
10	1.0	8.5	3.0x4.0	15.8	6.9	1
9	1.0	7.5	Not recorded	23.5	5.5	1
32	1.2	19.0	4.0x4.5	28.9	12.8	2
19	1.1	15.0	Not recorded	30.7	10.2	2
20	1.1	15.0	5.0x6.5	48.9	11.5	1
16	0.9	13.0	3.0x5.0	34.5	6.8	2
Av. 13.5	1.1	9.78	2.8x3.79	37.8	7.26	

Copris tullius Oliv.

Copris tullius Oliv. is a black beetle considerably smaller than **P. carolinus** but resembling it to a certain extent. Its habits of pushing out the soil in cylinder-like masses and burrowing at the edge of fresh cattle droppings are similar to those of **P. carolinus,** but the structure of the burrow is different in that it has no branch and the manure is stored in the form of a ball at the end of the burrow (Plate II, Fig. 4). The ball did not occupy the entire cavity inasmuch as a distance of about one-half centimeter separated it from the earthen wall. The tunnel usually entered the ground at a slight angle and continued with few or no turns (Plate I, Fig. 3). The walls of the passage-way were smooth and tubular.

The mounds of soil excavated by **C. tullius** were not easily distinguished from those of **Phanaeus spp.** because they were often nearly the same size. When the burrow was opened and its diameter noted, the occupant could be determined by the size of the tunnel, the smaller being that of **C. tullius.**

The first activity of these beetles in 1930 was observed on May 1. Evidence of considerable activity at this time was shown by a count of 22 burrows in a distance of 20 linear feet. During the extremely hot and dry weather in July and the first of August scarcely any burrowing was done by this insect. In September and the first part of October they were working in fresh dung in good numbers. A census of a one-tenth acre plot on October 25 revealed a count of 18 fresh mounds.

Table II gives the data on each burrow of **C. tullius** that was excavated. The average amount of dung stored was 7.26 grams, and the average amount of soil excavated was 36.88 grams.

Phanaeus spp.

Two species of **Phanaeus** were found in this study, and the data in Table III does not distinguish between them. The beetles are much alike in appearance, and it appears that differences in burrowing habits are not marked. Table III gives the record of burrows excavated. It will be noticed that only five of the 17 burrows were branched; thus, branching does not appear to be a characteristic. The average amount of manure buried and soil excavated was 9.62 and 93.4 grams respectively. Dung was stored in the terminations of all burrows excavated (Plate II, Fig. 5). The path of the tunnels was tortuous but regular throughout (Plate I, Fig. 4). The first burrowing was observed on May 1. The beetles were abundant throughout May and again in the latter part of August and September. On October 17, the last burrow in dung was recorded.

TABLE III

Showing Data on 17 Spring, Summer, and Fall Burrows of **Phanaeus** spp.

Dimensions of burrows in cm.				Weight of soil in grams	Cubic contents of burrows in cc.	Weight of manure in grams	Number of beetles in burrow
Length of main tunnel	Length of branch	Diameter	Depth				
20	None	1.5	4	32.1	35.3	8.5	2
3	None	1.4	2	Burrow not completed			1
11	None	1.3	3	No col.	13.2	2.6	2
24	None	1.8	7	No col.	61.1	No col.	2
9	8	1.9	5	149.5	49.1	10.1	1
14	None	1.6	4	No col.	28.1	No col.	1
15	None	1.3	3	160.4	19.8	2.5	1
16	None	1.8	7	No col.	40.7	13.3	1
20	None	1.7	8	152.2	45.2	5.5	2
15	8	1.5	9	102.2	40.5	30.2	2
18	6	1.5	8	No col.	42.1	21.1	2
11	None	1.8	7	31.5	28.0	6.5	1
17	10	1.5	10	No col.	65.1	5.2	1
11	None	1.4	7	No col.	16.9	10.6	1
16	None	1.5	8	No col.	28.2	4.3	1
12	None	1.4	6	No col.	18.4	6.6	1
12	4	1.3	7	26.5	21.1	7.8	1
Av. 14.3	7.2	1.54	6.1	93.4	34.5	9.2	1

One- and Two-Beetle Burrows

In Tables I, II and III it will be observed that some burrows are inhabited by two beetles. This characteristic is not confined to any particular season, but is prevalent throughout the burrowing period. Only eight, or 38 per cent, of the burrows of **P. carolinus** were inhabited by two beetles. It is interesting to note that 34.7 per cent of the burrows of **C. tullius** and 35.2 per cent of the burrows of **Phanaeus** spp. were occupied by two beetles. It will be noticed that where two beetles were present in a burrow its dimensions were usually greater than where only one occupied the home. Likewise more soil was transported to the surface and more manure deposited. A comparison of the averages of one-beetle and two-beetle burrows for **P. carolinus, C. tullius** and **Phanaeus** spp. is shown in Table IV. An examination of the part of the table concerning **P. carolinus** shows that in every dimension except diameter the two-beetle burrows exceed the one-beetle burrows. The average length of the main tunnels of the burrows in which one adult of **P. carolinus** was present was found to be 31.8 centimeters, while those in which two beetles belonging to that species were found averaged 63.1 centimeters. In this instance the ratio of the length of the main tunnel of the one-beetle burrows to the two-beetle burrows was 1:2. A similar ratio has been calculated for the length of the branch, depth of burrow, weight of soil excavated, weight of manure deposited in the ground and cubic contents of burrows. The ratios indicate that two beetles accomplish approximately twice as much as one, since the average of these ratios is 1:1.88 with a range of 1:1.3 for the minimum and 1:2.2 for the maximum.

A comparison of the one- and two-beetle burrows of **C. tullius** and **Phanaeus** spp. revealed that more work was accomplished when two beetles were in the burrow. The average of the ratios for **C. tullius** is 1:1.55, while for **Phanaeus** spp. it was 1:1.51.

TABLE IV.

Showing Comparison of One- and Two-Beetle Burrows of **Pinotus carolinus, Copris tullius** and and **Phanaeus** spp.

Species		Number of burrows of each kind	Average dimensions of burrows in cm.					Weight of soil in grams	Cubic contents of burrows	Weight of manure in grams
			Length of main tunnel	Length of branch	Diameter	Depth	Manure cavity			
Copris tullius	One beetle	13	31.8	15.7	2.68	18.0		159.5	247.5	35.6
	Two beetles	8	63.1	28.5	2.83	24.1	none	344.2	563.3	68.7
	Ratio		1:2	1:1.8	1:1	1:1.3		1:2.1	1:2.2	1:1.9
Pinotus carolinus	One beetle	15	11.6		1.08	8.26	2.45x3.37	28.7	not calculated	5.37
	Two beetles	8	17.1	none	1.12	12.6	3.5 x4.5	46.9		10.5
	Ratio		1:1.47		1:1	1:1.52	1:1.4 1:1.3	1:1.63		1;1.95
Phanaeus spp.	One beetle	11	12.3	not measured	1.53	6.6	none	not calculated	31.5	7.43
	Two beetles	6	18.0		1.55	6.5	none		39.5	13.6
	Ratio		1:1.46		1:1	1:1			1:1.25	1:1.83

Fall Burrows

It has been stated in a preceding paragraph that during the spring, summer and early fall dung beetle burrows were always within a few inches of fresh cattle droppings. Beginning on October 5, however, many fresh mounds of soil were observed from 18 inches to several yards away from dung. A number of these burrows of each species were excavated and it was found that they differed from those at the edge of fresh cattle droppings in that the tunnels went straight down without any branch or pocket, they had no stored manure, and that the passage-ways were packed with soil for the greater part of their lengths. A single beetle was found in the termination of each shaft.

The average depth of the fall burrows of **P. carolinus** was 57 centimeters, over twice the depth of those excavated earlier in the year. The average depth of the fall burrows of **C. tullius** was 22 centimeters, nearly two and one-half times the depth of the earlier burrows, while with **Phanaeus** spp. the depth was 32 centimeters, slightly over five times the depth of the earlier burrows. Inasmuch as previously marked burrows of this type were excavated in December, and live beetles found therein, it is the belief of the writer that these may be the overwintering quarters of these species.

Infestation of Definite Areas

A census of the dung beetles having freshly dug mounds of soil was taken on two one-tenth acre plots in a blue grass pasture in May and again in a similar area in the same pasture in June. This census included the burrows of **P. carolinus, C. tullius** and **Phanaeus** spp. Table V shows the number of fresh droppings, percentage of infestation and an estimation of dung beetles to an acre. The May census showed an average of 28 droppings to the plot, 45 per cent of which were infested, while in June there were 58 droppings and 40.5 per cent infestion. The estimation of the number of beetles to an acre was 120 in May and 235 in June. These figures represent the minimum, since some droppings have more than one burrow at their margins. Only fresh mounds of soil were counted. Rain usually obliterates traces of old mounds, so the new burrows that were constantly being made were easily identified. Whether the constant burrowing was brought about by a beetle making several burrows or by different generations of the species was not determined.

TABLE V.

Data on the Census of Dung Beetles in One-Tenth Acre Plots.

Plot	Date	Number of fresh droppings	Number of droppings infested	Percentage of infestation	Number of beetles to an acre
A	5-4-30	39	15	38	150
B	5-4-30	17	9	52	90
Average		28	12	45	120
C	6-3-30	65	25	38	250
D	6-3-30	51	22	43	220
Average		58	23.5	40.5	235

Onthophagus pennsylvanicus Har. and **Onthophagus hecate** Panz.

In the latter part of June while examining soil under dried cow dung, a number of oblong manure pellets were found. The pellets varied in depth from three to 17 centimeters, and there was no indication of a tunnel to the surface of the soil. Evidently these manure balls had been buried and the tunnels packed with soil some time before. Possibly this took place in early spring, since the droppings were dry but did not appear to have weathered over winter. In each of the balls was a small, hump-backed white larva. The pellets were of two sizes, the larger ones having an average length of 17 millimeters, while the diameter was 8.5 millimeters. The average length and diameter of the small pellets were nine and five millimeters, respectively. (Plate II, Figs. 1 and 3.)

A number of pellets were placed in the cave at the field insectary. From the small balls were bred **Onthophagus pennsylvanicus** Har. The period of emergence was from July 19 to July 21. The large balls contained larvae of **Onthophagus hecate** Panz. Emergence took place between August 25 and September 5. The pupal cases were black, nearly round and rather brittle. They had been formed from the manure in which the larvae had developed. A considerable portion of dung

remained after the insects transformed from the larval to the pupal stage and would no doubt be of value to the soil. The average weight of the large ball was 0.26 grams, while the weight of the small one was 0.11 grams.

Soil was examined for manure pellets under 43 droppings in three different pastures. Pellets were found under 76.6 per cent of the droppings, with an average of 11.2 pellets under each infested dropping.

SUMMARY

In the vicinity of Manhattan, Kansas, dung beetles were found in every environment where cattle grazed.

Dung was buried from the first of May until early fall by **Pinotus carolinus, Copris tullius** and **Phanaeus** spp.

Pinotus carolinus makes a branched burrow and an average of 48.5 grams of cattle dung is stored in the branch of each burrow, while 287.1 grams of soil are excavated. **Copris tullius** excavates a burrow which terminates in an oblong cavity where a ball of manure is stored. The average amount of soil brought to the surface and manure deposited was 37.8 and 7.26 grams respectively. **Phanaeus** spp. store dung at the end of their burrows. The average weight of soil and manure was 93.4 and 9.62 grams respectively.

In the fall these insects constructed burrows which differed from those made earlier in the year in that they went straight down without any pocket or branch and had no stored manure. It is believed that the fall burrows are the overwintering quarters of the species.

When two beetles occupied the burrow, the amounts of manure stored and soil excavated were greater than when only one insect was present. **Pinotus carolinus, C. tullius** and **Phanaeus** spp. had 38 per cent, 34.7 per cent and 35.2 per cent, respectively, of their burrows occupied by two beetles.

In May and June, 42.7 per cent of the fresh cattle droppings on two one-tenth acre plots had newly made dung beetle burrows at their margins.

A census of two one-tenth acre plots in September showed an average of 20 fresh mounds of **P. carolinus** on each plot.

Under 76.6 per cent of dry cattle droppings were found small manure pellets which were the larval homes

of **Onthophagus pennsylvanicus** and **Onthophagus hecate.**

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1891. The Origin and Nature of Soils.
Twelfth Ann. Rept., U. S. Geol. Surv:, Pt: I:213-345:

Explanation of Plates

Plate I.

Diagram of Dung Beetle Burrows.

Diagrams of the burrows of **Pinotus carolinus, Copris tullius,** and **Phanaeus** spp., showing their comparative size.

Plate II.

Manure Stored by Dung Beetles.

Photograph of manure showing the form in which it is stored by different species of dung beetles.

Fig. 1. **Onthophagus hecate.**
Fig. 2. Pupal cases of **Onthophagus hecate.**
Fig. 3. **Onthophagus pennsylvanicus.**
Fig. 4. **Copris tullius.**
Fig. 5. **Phanaeus** spp.
Fig. 6. **Pinotus carolinus.**

Plates photographed by Mr. Floyd Hanna, Kansas State College photographer.

PLATE I

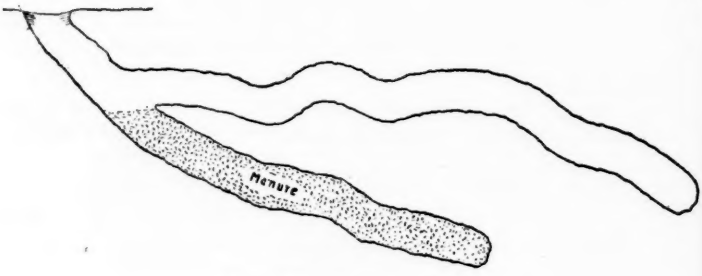


Fig. 1 Pinotus carolinus

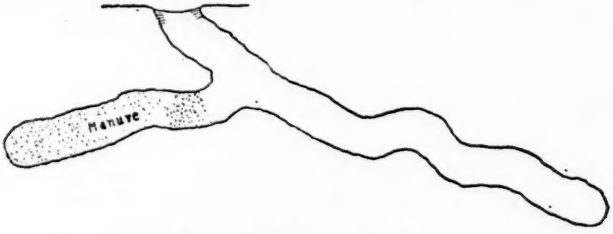


Fig. 2 Pinotus carolinus

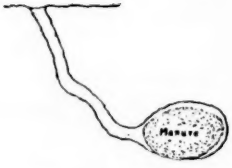


Fig. 3 Copris tullius

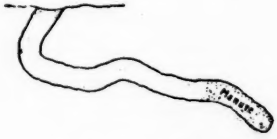
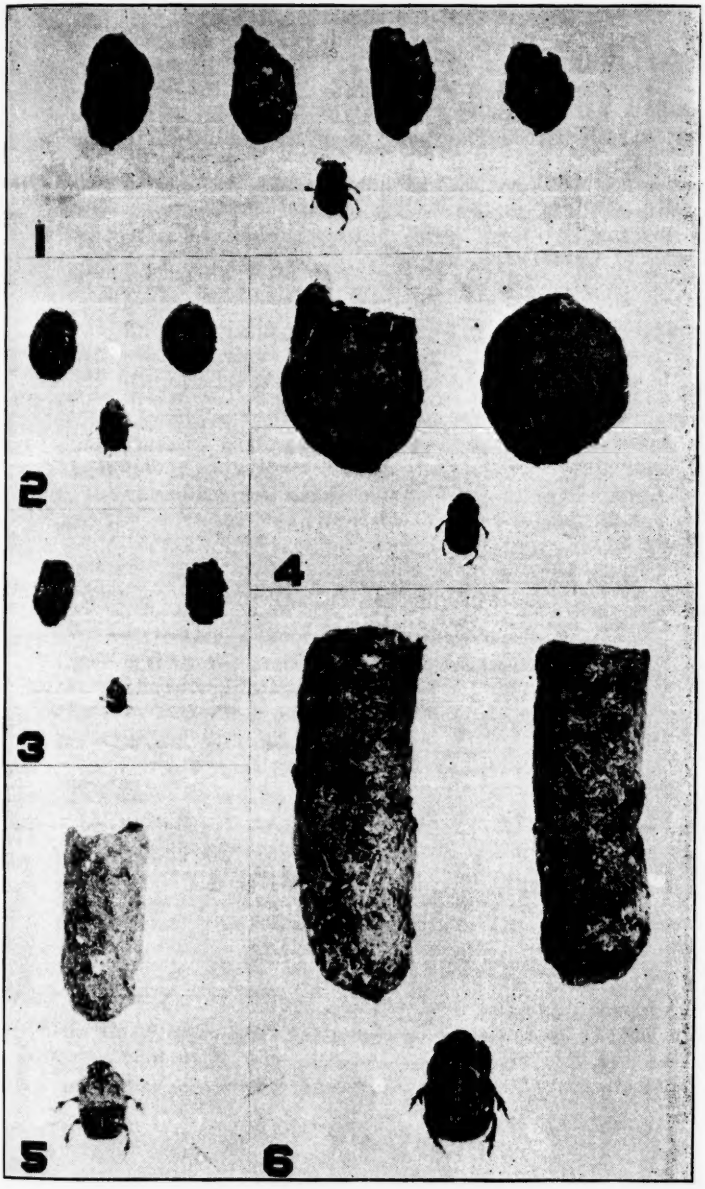


Fig. 4 Phanaeus spp.

PLATE II



THE GENERA STIRELLUS AND COMMELLUS (HOMOPTERA, CICADELLIDAE)

RUTH L. THOMAS, Lawrence, Kansas *

The subgenera **Stirellus** and **Commellus** were established by Osborn and Ball (1) in 1902 to include small groups of leafhoppers formerly included in the genus **Athysanus.** Ball (2) in 1929 raised them to generic rank. Three species have previously been known in each of these genera. This paper adds two new species and two new varieties to **Stirellus** and a new species to **Commellus.**

KEY TO SPECIES OF STIRELLUS

1. Elytra distinctly greenish yellow usually striped with black 2
   Elytra usually light to dark brown marked with fuscous 3
2. Apex of vertex entirely black, male plates truncate ..... **bicolor** (Van Duzee)
   Apex of vertex light or with light line or spots, male plates convex ..**dixianus** var. **robustus** var. n.
3. Vertex usually broadly obtuse, elytral veins light with distinct brown stripes between ..... **mexicanus** (Osborn & Ball)
   Vertex more acute, elytra not as above 4
4. Both sexes distinctly brown, veins light except apical ones, elytra usually longer than ovipositor 6
   Females yellowish often with fuscous claval and apical nervures, males usually darker, elytra shorter than ovipositor 6
5. Vertex with two or four small spots, male plates convex, species lighter ..... **convexus** sp. n.
   Vertex with two large spots and usually two smaller ones, male plates truncate, species darker ..... **obtutus** (VanDuzee)

(1). Review of North American Species of Athysanus, Osborn and Ball, Ohio Naturalist, II, p. 250, 1902.

(2). A supplemental revision of the genus Athysanus in North America, Ball, Trans. Ent. Soc. of Am., IV, p. 2, 1929.

* Contribution from Department of Entomology, University of Kansas.

6. Vertex quite acute, slender species, usually light ..... **dixianus** var. **acutus** var. n.

Vertex more obtuse, more robust species, usually darker ..... **dixianus** sp. n.

Stirellus bicolor (VanDuzee)

Pl. I, figs. 4, 4a; Pl. II, figs. 1, 1a, 1b.

Athysanus bicolor Van. D. Can Ent., XXIV p. 114, 1892.

A striking black and yellowish-green species. Length of female 3.5 mm.; male 3 mm.

Head slighty wider than pronotum. Vertex slightly longer at middle than width between eyes, nearly one-half longer at middle than next the eye. Pronotum more than twice as wide as long, slightly longer than vertex in male, definitely longer in female; lateral margins very short, humeral margins long, posterior margin barely emarginate. Elytra exceeding abdomen in male, distinctly or but slightly shorter than ovipositor in female; rounding apically, venation indistinct.

Color: Vertex with anterior half solid black; posterior half yellow. Pronotum yellowish green with anterior black band. Scutellum with black basal band and yellowish-green tip. Elytra greenish yellow with humeral, sutural, and apical margins, and claval suture fuscous or black, and frequently with fuscous stripes extending obliquely backward from middle of costal margin; fuscous markings more prominent in male, sometimes whole elytron dark. Face black, with broad, transverse, yellow band below eyes. Venter fuscous to black.

Genitalia: Plates about as long as last ventral segment, truncate, slightly exceeding triangular valve and bearing row of stout marginal spines. Pygofer extending beyond plates about one-half length of latter. Female last ventral segment as long as penultimate, posterior margin shallowly excavated. Pygofer rather robust, sparsely spined. Ovipositor greatly exceeding pygofer.

Distribution: Hitherto recorded chiefly from the south but extending as far north as Michigan and as far west as Kansas and Nebraska. Specimens at hand now

extend the range southwest to Arizona. It is also known from neotropical regions.

This species was described from a specimen from Mississippi and one from Kansas. Judging from the description these two specimens are not alike in color markings and the Kansas specimen may represent the species here described as **dixianus** var. **robustus.** The first mentioned specimen, the one from Mississippi, was kindly loaned for study by Dr. H. H. Knight of the Iowa State Agricultural College. It has the apex of the head solid black and, therefore, definitely fixes the status of the species.

Stirellus obtutus (VanDuzee)

Pl. I, figs. 6, 6a; Pl. II, fig. 5.

Athysanus obtutus VanD. Can. Ent., XXIV, p. 115, 1892.

A distinctly brownish species; vertex marked with two large, black spots and usually two smaller posterior ones. Length of female 3.5 mm.; male 3 mm.

Head of about the same width as pronotum. Vertex slightly longer at middle than width between eyes, nearly one-half longer at middle than next the eye. Pronotum more than twice as wide as long; slightly longer than vertex; lateral margins very short, humeral margins long, posterior margin slightly emarginate. Elytra exceeding abdomen in male, and reaching tip of ovipositor in female; rounding apically, venation distinct particularly the apical veins.

Color: Vertex brownish or testaceous with a pair of dark, irregular spots on anterior margin, frequently confluent in male; two large, nearly square, black spots encircled by a paler area on disc, frequently a smaller pair behind them. Pronotum brownish with a row of dark, irregular spots near anterior margin merging in male to form band. Scutellum brownish with basal angles darkened and sometimes with dark spot between. Elytra fuscous with light nervures except for the apical ones which are strongly fuscous. Face light with dark arcs frequently converging to form a dark spot on upper part of front; apex of clypeus fuscous. Venter dark

with yellowish markings.

Genitalia: Plates truncate, slightly exceeding triangular valve, and bearing a few submarginal spines. Pygofer nearly twice the length of the plates. Female last ventral segment as long as penultimate, posterior margin slightly sinuate. Pygofer rather narrow, sparsely spined. Ovipositor greatly exceeding pygofer.

Distribution: Widely distributed in southern states from Maryland to Arizona. Specimens are at hand from Louisiana, Missouri, and Kansas.

Through the courtesy of Dr. H. H. Knight of the State Agricultural, Ames, Iowa, the type specimen of this species was also examined.

Stirellus mexicanus (Osborn & Ball)

Pl. I, figs. 1, 1a; Pl. II, figs. 2, 2a.

Athysanus mexicanus Osborn & Ball. Ohio Naturalist, II, p. 254, 1902.

A yellowish-green species with brown stripes usually with broadly rounded vertex. Length of female 3.8 mm.; male 2.8 mm.

Head slightly wider than pronotum. Vertex narrow, distinctly longer at middle than width between eyes, slightly longer at middle than next the eye. Pronotum more than twice as wide as long, usually slightly longer than vertex; lateral margins very short, humeral margins long, posterior margin slightly emarginate. Elytra exceeding abdomen in male, distinctly shorter than ovipositor in female; rounding apically.

Color: Vertex dull yellow with two large, black spots near anterior margin. Pronotum greenish yellow with row of small confluent spots near anterior margin; markings often indistinct. Scutellum yellow with two indistinct, brownish triangles at base. Elytra yellowish or greenish yellow with distinct, brownish, longitudinal stripes and light nervures. Face yellowish, sutures dark, front with dark arcs. Venter yellow.

Genitalia: Male plates convexly rounding, twice as long as triangular valve and bearing a row of stout marginal spines. Pygofer extending slightly beyond plates. Female last ventral segment nearly twice longer than penultimate, posterior margin slightly sinuate to truncate. Pygofer long, slender, sparsely spined. Ovipositor longer than in **S. bicolor.**

Distribution: Specimens at hand from Victoria, Aransas, and Brooks counties, Texas, give the first record for this species outside of Mexico.

Stirellus convexus sp. n.

Pl. 1, figs. 2, 2a; Pl. II, figs. 4, 4a, 4b.

Resembling **S. obtutus** but lighter and with smaller spots on vertex. Length of female 3.5 mm.; male 3.2 mm.

Head slightly wider than pronotum. Vertex slightly longer at middle than width between eyes, nearly one-half longer at middle than next the eye. Pronotum over twice as wide as long; about the same length as the vertex; lateral margins very short, humeral margins long, posterior margin barely emarginate. Elytra exceeding abdomen in male, as long as or slightly shorter than ovipositor in female; rounding apically.

Color: Vertex fulvous with two pairs of dark spots on disc, posterior pair small, frequently indistinct. Pronotum fulvous with a row of small dots parallel to anterior margin, middle pair frequently elongated. Scutellum yellowish brown with two pairs of dark spots along basal margin, outer pair frequently extending under pronotum. Elytra brownish with pale nervures except for apical ones which are fuscous. Face pale brown with dark arcs, dark band across apex of clypeus. Venter dark with yellowish markings.

Genitalia: Plates convexly rounding slightly exceeding valve and bearing row of stout marginal spines. Pygofer wider and nearly one-half longer than plates and lacking the small lateral spines found in all other members of the genus. Female last ventral segment about one-third longer than preceding segment, posterior margin shallowly excavated. Pygofer rather narrow, sparsely spined. Ovipositor greatly exceeding pygofer.

Holotype, male, Douglas County, Kansas, April 10, 1923. H. B. Hungerford. **Allotype,** female, Douglas County, Kansas, April, 1923. R. H. Beamer.

Paratypes, four females from Atherton, Missouri; Caddo Parish, Louisiana; Ames, Iowa; and Douglas County, Kansas. Two males from Ames, Iowa, and Bluff City, Kansas.

Types deposited in Snow Entomological Collection.

Stirellus dixianus sp. n.

Pl. I, figs. 5, 5a; Pl. II, figs. 3, 3a.

Similar to **S. bicolor** but lighter and with apex of vertex light. Length of female 3.6 mm.; male 3 mm.

Head about the same width as pronotum. Vertex distinctly longer at middle than width between eyes, nearly one-half longer at middle than next the eye. Pronotum over twice as broad as long; as long as or slightly shorter than vertex; lateral margins very short, humeral margins long, posterior margin slightly emarginate. Elytra greatly exceeding abdomen in male, distinctly shorter than ovipositor in female; rounding apically, apical cells short.

Color: Vertex yellow with two pairs of dark spots, anterior pair large and frequently confluent in male to form dark band across vertex, posterior pair small, frequently indistinct or lacking. Pronotum yellowish or greenish yellow with a pair of large, irregular, dark spots on anterior margin which usually fuse in male to form a dark band. Scutellum yellow with two to four dark spots along base which extend under pronotum, and are frequently nearly or entirely confluent to form dark basal band. Elytra subhyaline or yellowish green, usually with fuscous claval sutures and apical nervures; male frequently with whole elytron dark or subhyaline with irregular, dark stripes. Face brownish or fuscous with dark arcs, with pale transverse band below eyes, and apex of clypeus dark brown. Venter dark in male, yellowish with dark markings in female.

Genitalia: Plates about as long as last ventral segment convexly rounding, nearly one-third longer than triangular valve and bearing marginal row of stout spines. Pygofer extending beyond the plates about one-half the length of the latter. Female last ventral segment slightly longer than penultimate, posterior margin slightly concave. Pygofer rather robust, sparsely spined, and greatly exceeded by ovipositor.

Holotype, male, Shuqualak, Mississippi, July 16, 1930, Paul W. Oman. **Allotype,** female, Fulton, Mississippi, July 14, 1930, L. D. Tuthill.

Paratypes, fifteen females from Fulton and Shuqualak, Mississippi; and Walnut, North Carolina. Eight males from Fulton, Shuqualak, and Weir, Mississ-

ippi; and Walnut, North Carolina.

This species has formerly been included in **S. bicolor.** It has, however, the tip of the vertex light, back of which are two dark spots which may be more or less confluent, whereas in **bicolor** the entire apical half of the vertex is solid black. Also the male plates are rounded while they are truncate in **bicolor.**

Types deposited in Snow Entomological Collection.

Stirellus dixianus var. **robustus** var. n.

Pl. I, figs. 7, 7a.

Similar to **S. dixianus** but slightly larger and more robust. Vertex more broadly rounding. Length of female 3.8 mm.; male 3.2 mm.

Color: Vertex yellow with a pair of large, dark spots frequently partly or entirely confluent forming dark band just back of anterior margin, tip of vertex yellow or separated from dark band by a yellow line or spot. Pronotum greenish yellow with a pair of large, dark spots usually forming a black band across anterior margin. Scutellum yellowish usually with a black basal band. Elytra greenish yellow with fuscous markings nearly lacking in some females or more usually with fuscous marks along sutural and claval sutures, in apical cells and sometimes one or two stripes extending obliquely backward from near middle of costa.

Holotype, female, Greenwood County, Kansas, August 2, 1932. R. H. Beamer and P. B. Lawson. **Allotype,** male, same place and data as for holotype.

Paratypes, forty-two females and seven male specimens, the majority of which were collected in Greenwood, Montgomery, and Wilson counties, Kansas. Other localities in which specimens were taken include Woodson, Cherokee, Republic, and Phillips counties, Kansas; Shuqualak and Hamilton, Mississippi; and Kerr, Hidalgo, and Palopinto counties, Texas.

Types deposited in Snow Entomological Collection.

Stirellus dixianus var. **acutus** var. n.

Pl. I, figs. 3, 3a.

Similar to **S. dixianus** but slender with a distinctly more acute vertex. Length of female 3.5 mm.; male 2.8 mm.

Color: General color light brown. Vertex straw yellow with two pairs of dark spots, anterior pair larger occasionally confluent in male; posterior pair frequently indistinct or lacking. Pronotum yellowish with row of dark spots near anterior margin, median pair usually largest. Scutellum yellowish with two pairs of dark spots, outer pair extending under pronotum. Elytra subhyaline usually with fuscous apical nervures. In male fuscous markings more prominent, claval sutures, apical cells, and stripes on elytra frequently fuscous. Face brownish to nearly black with dark arcs, yellowish transverse band below eyes, apex of clypeus usually dark. Venter dark in male, light in female.

Holotype, male, Hilliard, Florida, August, 31, 1930, R. H. Beamer. **Allotype,** female, Hilliard, Florida, August 31, 1930, R. H. Beamer.

Paratypes, thirty-nine females from Hilliard, Loughman, Yankeetown, Florida; Tupelo, Fulton, and Woodville, Mississippi; Callion, Alabama; and Natchitoche County, Louisiana. Thirteen males from Hilliard, Loughman, Plant City, Florida; and Woodville, Mississippi.

Types deposited in Snow Entomological Collection.

The Genus **Commellus** Osborn & Ball

Key to Species

1. Two pairs of large, black spots on margin of vertex 2
   One pair of large, black spots on margin of vertex 3
2. Elytra with four separate stripes ..... **comma**
   Elytra with eight separate stripes ..... **colon**
3. Margin of vertex acute, disc flat or slightly concave ..... **planus** sp. n.
   Margin of vertex not acute, disc convex..**sexvittatus**

Commellus planus sp. n.

Pl. I, fig. 9; Pl. II, figs. 7, 7a.

Similar to **C. sexvitattus,** but with vertex slightly concave and with sharp anterior margin. Length of female 5 to 5.5 mm.; male 3.8 to 4.2.

Head slightly wider than pronotum. Vertex nearly two-thirds wider between eyes than length at middle, nearly one-half longer at middle than next the eye; anterior margin turned slightly upward to form distinctly concave disc, sharply angled with front. Pronotum over two and one-half times as wide as long; about the same length as the vertex; lateral and humeral margins long, posterior margin slightly emarginate. Elytra usually shorter than abdomen in both sexes but slightly longer, narrower, and with fewer cross-veins than in **sexvittatus.**

Color: Pale or straw colored marked with brown and black. Vertex with two black marginal spots cut off from front by a distinct suture, and two pairs of brown to nearly black spots caudad of these. Pronotum with six, brown to black, longitudinal stripes, the two median ones extending across scutellum. Elytral nervures and sutures broad and pale with distinct, brown stripes between. Apical cells distinct, bordered with dark brown. Face pale frequently with faint, brownish arcs, sutures slightly darkened and with small, frequently indistinct, dark spots above antennae and larger ones below eye.

Genitalia: Plates twice as long as large, triangular valve, gradually tapering to broad apices, with acute meso-caudal angles, and slightly shorter than the robust pygofer. Female last ventral segment over twice longer than preceding, posterior margin with a large notch which extends over half way to base, its sides very slightly sinuate, its apex very broadly rounding with a narrow slit extending through the dark spot at apex of notch. Pygofer robust, slightly exceeded by ovipositor, sparsely spined.

Holotype, male, Barclay, Utah, July 2, 1921. R. H. Beamer. **Allotype,** female, Barclay, Utah, July 2, 1931. R. H. Beamer.

Paratypes, fifteen females and fifteen males all of which were collected at Barclay, Utah, July 2, 1931, by R. H. Beamer.

The tips of the male plates are more rounded in **C. sexvittatus** and the apex of the notch in the last ventral segment of the female is much more obtuse.

Types deposited in Snow Entomological Collection.

PLATE I

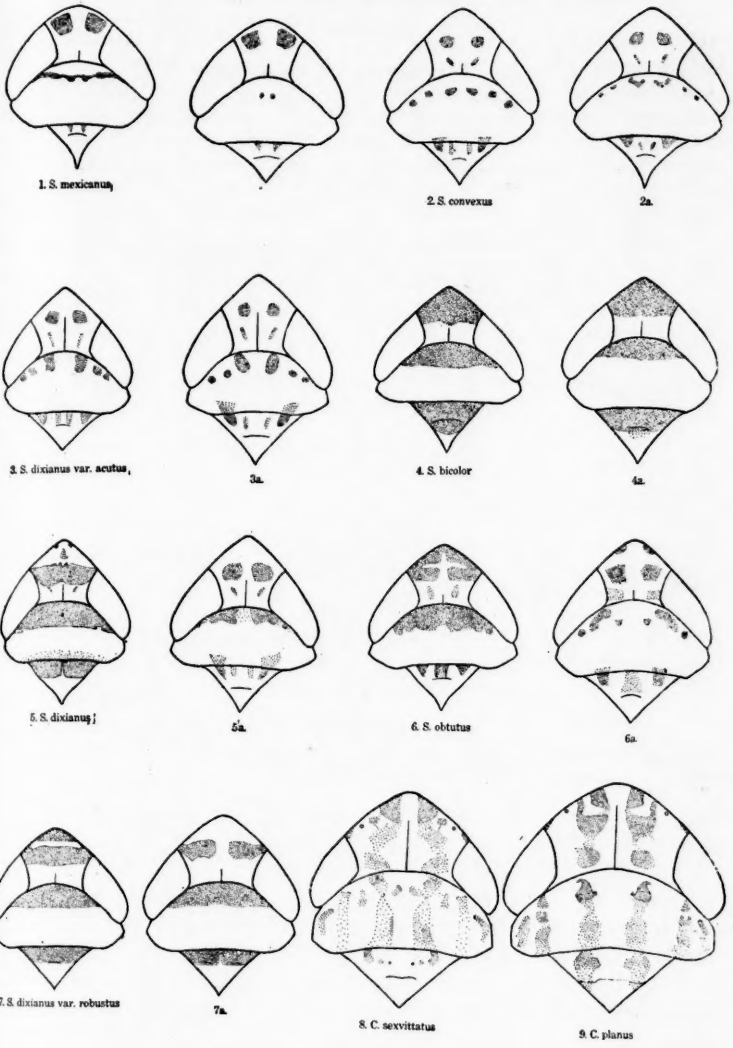
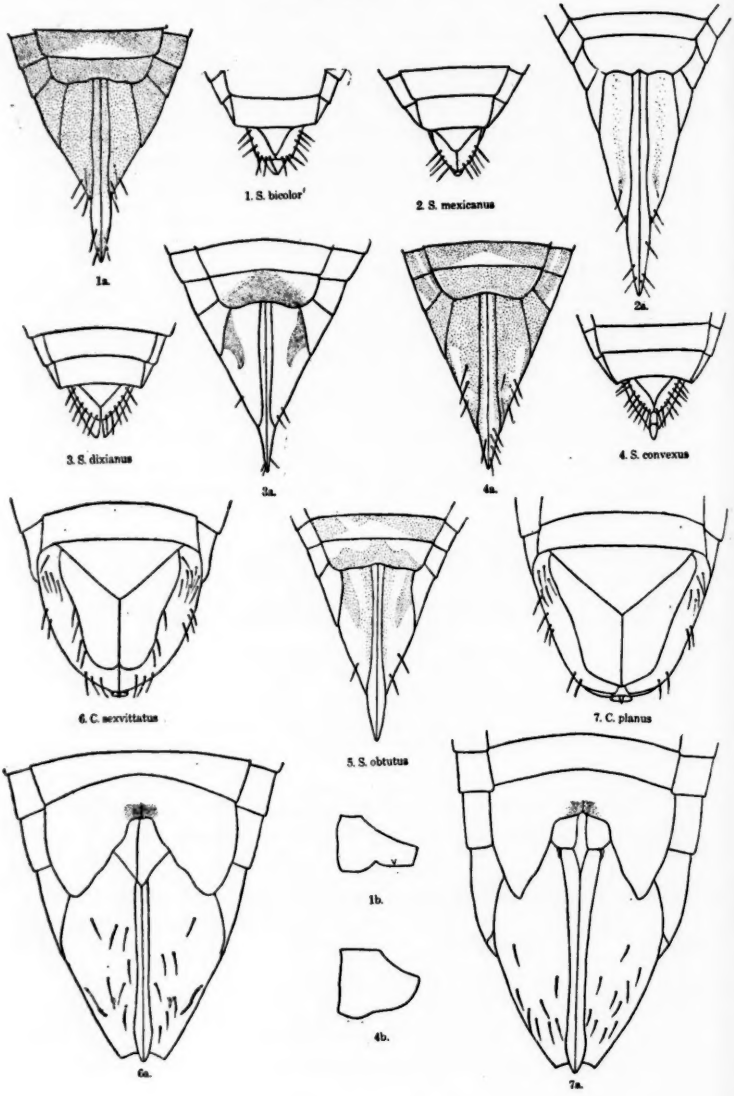

1. S. mexicanus,
2. S. convexus
2a.
3. S. dixianus var. acutus,
3a.
4. S. bicolor
4a.
5. S. dixianus,
5a.
6. S. obtutus
6a.
7. S. dixianus var. robustus
7a.
8. C. sexvittatus
9. C. planus

PLATE II


1a.
1. S. bicolor
2. S. mexicanus
2a.
3. S. dixianus
3a.
4a.
4. S. convexus
6. C. sexvittatus
5. S. obtutus
7. C. planus
1b.
4b.
6a.
7a.

PUBLICATIONS OF THE LATE PROFESSOR JAMES WALKER McCOLLOCH (1889-1929).

ROGER C. SMITH

It is customary to record the list of the published, scientific contributions of prominent entomologists and other scientists. This is being done herewith in the case of the late Professor James Walker McColloch, editor of the first two volumes of this Journal and, for 19 years, a member of the Entomolgical staff at Kansas State College. Obituaries of Professor McColloch were published in the Journal of Economic Entomology, Vol. 22, No. 6, 990-991, 1929, by Professor George A. Dean; in the Journal of the Kansas Entomological Society, Vol. 3, No. 2, 51-52, 1930, by Dr. R. L. Parker and in the Annals of the Entomological Society of America, Vol. 23, No. 1, 195-196, 1930, by Dr. W. P. Hayes. The list of his entomological papers, which is believed to be complete, is given in chronological order:

1. Dean, G. A. and McColloch, J. W.
   1913. The chinch bug situation in Kansas. Kans. State Exp. Sta. Cir. 29, 6 p.

2. Headlee, T. J. and McColloch, J. W.
   1913. The chinch bug. Kans. State Agr. Exp. Sta. Bul. 191, 287-352.

   McColloch, James W.
   1913. A parasite of the Chinch Bug Egg. Can. Ent. 45:342-343.

3. McColloch, J. W.
   1914. A parasite of the chinch bug egg. Jour. Econ. Ent. 7:219-227.

4. Dean, G. A. and McColloch, J. W.
   1914. Burn the chinch bug in winter quarters. Kans. State Agri. Exp. Sta. Cir. 32, 7 p.

5. Dean, G. A. and McColloch, J. W.
   1914. The hessian fly situation in Kansas. Kans. State Agr. Exp. Sta. Cir. 37, 4 p.

6. McColloch, J. W.
   1915. Recent results in the use of dust sprays for controlling the corn earworm. Jour. Econ. Ent. 8:211-214.

7. McColloch, J. W. and Yuasa, Y.
1915. Further data on the life economy of the chinch bug egg parasite. Jour. Econ. Ent. 8:248-260.

8. Dean, G. A. and McColloch, J. W.
1915. The hessian fly situation in Kansas (rev. ed.) Kans. State Exp. Sta. Cir. 37. 4 p.

9. McColloch, J. W. and Yuasa, H.
1915. A new parasite of the chinch bug egg (Hymen). Ent. News, 26:147-149.

10. McColloch, J. W. and Hayes, Wm. P.
1916. A preliminary report on the life economy of **Solenopsis molesta** Say. Jour. Econ. Ent. 9:23-38.

11. McColloch, J. W.
1916. Additional notes on the use of dust sprays against the corn earworm. Jour. Econ. Ent. 9:395-398.

12. ———
1916. Notes on the distribution of the clover leaf weevil in Kansas. Jour. Econ. Ent. 9:445.

13. ———
1916. Wind as a factor in the dispersion of the hessian fly. Jour. Econ. Ent. 10:162-168.

14. ———
1916. A method for the study of underground insects. Jour. Econ. Ent. 10:183-187.

15. ———
1917. Notes on false wireworms with especial references to **Eleodes tricostata** Say. Jour. Econ. Ent. 11:212-224.

16. McColloch, J. W. and Yuasa, H.
1917. Notes on the migration of the hessian fly larvae. Jour. Animal Behaviour 7:307-323.

17. McColloch, J. W. and Salmon, S. C.
1918. Relation of kinds and varieties of grain to hessian fly injury, a preliminary report. Jour. Agri. Res. 12(8):519-527.

18. McColloch, J. W.
1919. The toad as an enemy of the chinch bug. Jour. Econ. Ent. 12:124.

19. ———
1919. **Eleodes opaca** Say an important enemy of wheat in the great plains area. Jour. Econ. Ent. 12:183-194.

20. ———
1919. Variations in the length of the flaxseed stage of the hessian fly. Jour. Econ. Ent. 12:252-255.

21. Hayes, W. P. and McColloch, J. W.
1920. Some observations on the genitalia of Lachnosterna. Ent. Soc. Amer. Annals 13:75-80.

22. McColloch, James W.
1920. A study of the oviposition of the corn earworm with relation to certain phases of life economy and measures of control. Jour. Econ. Ent. 13:242-255.

23. ———
1921. A method for studying the hessian fly and other insects. Ent. Soc. Amer. Annals 14:227-230.

24. ———
1921. The corn leaf aphis (**Aphis maidis** Fitch) in Kansas. Jour. Econ. Ent. 14:89-94.

25. ———
1921. Summer measures for the control of the chinch bug. Kans. State Agri. Exp. Sta. Cir. 87, 8 p.

26. ———
1922. The Eleodes of Riley County, Kansas. Kans. Acad. Sci. Trans. 30:182-183.

27. McColloch, J. W. and Hayes, W. P.
1922. The Phyllophaga (Scarab. Coleop.) of hawthorn (Crataegus). Brooklyn Ent. Soc. Bul. 17:131-135.

28. ———
1922. The reciprocal relation of soil and insects. Ecology 3:288-301.

29. ———
1922. The Lachnosterna of the vicinity of Manhattan, Kans. Kans. Acad. Sci. Trans. 30:184-195.

30. ———
1922. An annotated list of some Kansas Pleurosticti (Scarabaeidae). Kans. Acad. of Sci. Trans. 30:345-351.

31. McColloch, J. W.
1922. Longevity of the larval stage of the cadelle. Jour. Econ. Ent. 15:240-243.

32. ———
1922. The attraction of **Chloridea obsoleta** to the corn plant. Jour. Econ. Ent. 15:333-339.

33. McColloch, J. W. and Hayes, W. P.
1923. Soil temperature and its influence on white grub activities. Ecology 4:29-36.

34. McColloch, J. W. and Salmon, S. C.
1923. The resistance of wheat to the hessian fly. A progress report. Jour. Econ. Ent. 16:293-298.

35. McColloch, J. W.
1923. The hessian fly in Kansas. Kans. Agr. Exp. Sta. Tech. Bul. 11, 96 p.

36. Hayes, W. P. and McColloch, J. W.
1924. A new species of Anomala (Coleop. Scarab). Ent. News 35:138-140.

37. ———
1924. The time of planting corn as a factor in earworm control. Jour. Econ. Ent. 14:320-323.

38. ———
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(HEMIPTERA-HYDROMETRIDAE)

H. B. HUNGERFORD, Lawrence, Kansas.*

The following undescribed marsh treader has come to the University of Kansas collection recently.

Hydrometra whitei sp. n.

Size and Color: Length, 13-15 mm. The females larger and more robust than the males. The general color brown above, often frosted below; a frosted band extends along the sides of the thorax and abdomen. Pronotum with median longitudinal frosted line margined by dark brown on posterior part. Hemelytra brown with broken longitudinal tan streak on the distal third near anterior margin, this appears as two or three tan streaks in a row to the right or left of the median line when the wings are closed.

Structural Characteristics:

Head: Length, 110 units (male); 135 units (female). The ratio of the anteocular part of the head to the postocular part is expressed by the formula AO:PO:: 76:30 (male); 88:35 (female). The dorsal interocular groove nearly equal to the diameter of an eye and shallow, the ventral groove well marked. The clypeus nearly as broad as long, obtusely pointed, nearly rounded and polished. The rostrum surpasses the eyes by about one-half the postocular distance. The antennal segments have the following ratio beginning with the basal one,

*Contribution from the Department of Entomology, University of Kansas.

20:36:140:65 (male).

Pronotum: Length, 60 units (male); 72 units (female). An encircling row of pits parallel to the anterior margin, a median row of pits on the posterior lobe and numerous other large pits.

Metanotum: Covered by the wings, which in nearly all the specimens studied are fully developed and do not quite reach anterior margin of the last abdominal segment in the male and are even shorter in the female.

Coxae: The distance between the first and second coxae is to that between the second and third coxae as 39:63 (male); 45:68 (female). All the acetabula are pitted each bearing numerous pits on either side of the cleft.

Femora: Anterior femora not attaining apex of head in the female, a little longer in the male. The hind femora surpassing the abdomen by one-fifth of their length even in the female.

Abdomen: Length, 145 units (male); 170 units (female). The male processes on the ventral side of the sixth segment mammilose, pointed, curved backward, quite widely separated and located anterior to the middle of the segment, not joined by a ridge. On the ventral anterior two-thirds of the seventh segment, on each side of the median longitudinal line, is a large depression fringed with hairs on the lateral and posterior margins. Short dorsal terminal processes are present in both sexes.

Described from eighteen specimens, four males and fourteen females collected by J. J. White in Rio Grande, British Hondurus, C. A., in February. Types in the Snow Entomological Collection.

Notes: In general appearance this species might be confused with **H. wileyi** Hungerford. The hind femora are relatively longer, the processes on the ventral side of the sixth segment of the male not so near the anterior margin and there are depressions on the seventh segment as described above.

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